Light Robotics – a growing toolbox for biomedical research

Bunea, Ada-Ioana; Glückstad, Jesper

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

Light Robotics – a growing toolbox for biomedical research

Ada-Ioana Bunea, Jesper Glückstad

Technical University of Denmark, Dept. of Photonics Engineering, DK-2800, Kgs. Lyngby, Denmark

Research in the field of injectables spans a wide range of disciplines, from the chemical synthesis of novel drug candidates to the engineering of improved devices for subcutaneous, intradermal or intramuscular administration of biopharmaceuticals. For understanding and overcoming existing challenges in the field, an interdisciplinary approach relying on the latest research tools is needed.

Light Robotics[1] might prove a valuable toolbox for research in the field of injectables. By combining intelligent optical actuation with a high degree of control over the shape and surface properties of microfabricated structures, Light Robotics enables active investigation of biological samples and processes.

As one of the pioneers in the field, our group develops microrobots for biomedical applications and advanced light sculpting techniques for their efficient optical manipulation. Two-photon polymerization enables direct laser writing of structures with a resolution of ~200 nm, which can be further improved to ~10 nm by post-processing or additional control over the printing process. In combination with surface modification *via* metal deposition or chemical functionalization, such microstructures can be tailored to specific applications for biomedical research purposes, such as material delivery[2] or localized mixing in microfluidic channels[3]. Light sculpting using methods from the Generalized Phase Contrast (GPC) family allows precise, simultaneous control of several microstructures with six degrees of freedom.

[1] Glückstad, J. & Palima, D. Light robotics: structure mediated nanobiophotonics (Elsevier, 2017).

[2] Villangca, M. J, Palima, D., Bañas, A. R. & Glückstad, J. Light-driven micro-tool equipped with a syringe function. *Light: Science & Applications* **5**, 2016, e16148.

[3] Engay, E., Bunea, A.-I., Chouliara, M., Bañas, A. & Glückstad, J. Natural convection induced by an optically-fabricated and actuated microtool with thermoplasmonic disk. *Optics Letters* **16**, 2018, 3870-3873.